Remarks

Amendments to Specification

The specification has been amended to include a paragraph on the penetration depth being "at least 5000Å" and from "one half to two thirds the thickness of the bond pads". This amendment is required to secure correspondence between the claims and the specification as required by 37 CFR §1.117. Antecedent basis for the added paragraph is contained in claims 2, 3 and 4 of parent application serial no. 08/073,003.

Rejections Under 35 USC §102 and 35 USC §103

Claims 78-82, 87, 88, 90-93 and 96-98 have been rejected under 35 USC §102(e), as being anticipated by Agahdel et al. (US Patent No. 5,402,077).

Claims 78-82, 87, 88, 90-93 and 96-98 have been rejected under 35 USC §103(a) as being unpatentable over Malhi et al. '190 (US Patent No. 5,088,190) or Elder et al. '850 (US Patent No. 5,123,850) in a first set, in view of Nakano (JP Hei 3-69131) in a second set, and Blonder et al. (US Patent No. 4,937,653) and Bindra et al. (US Patent No. 5,137,461) in a third set.

Claims 78-82, 87, 88, 90-93 and 96-98 have been rejected under 35 USC §103(a) as being unpatentable over Nakano et al. (JP Hei 3-69131) in a first set in view of Blonder et al. (US Patent No. 4,937,653) or Bindra et al. (US Patent No. 5,137,461) in a second set.

Claims 78-82, 87, 88, 90-93 and 96-98 have been rejected under 35 USC §103(a) over Agahdel et al. (US Patent No. 5,402,077).

In response to the 35 USC §102 and 35 USC §103 rejections the claims have been amended, or in the

alternative the rejections are traversed in view of the arguments to follow.

Summary of the Invention

The pending claims are directed to an "apparatus for testing semiconductor dice having a plurality of pads". The apparatus (fixture 11-Figure 8) includes a plate for retaining the die (die cavity plate 13-Figure 8), and a clamping mechanism (clamp 89-Figure 8). The testing apparatus also includes a substrate (41-Figure 6) configured to make temporary electrical connections with the die (21-Figure 6) held in the testing apparatus (fixture 11-Figure 8). The substrate (41-Figure 6) includes contacts (61-Figure 8) with raised portions (73-Figure 6) for penetrating pads (27-Figure 6) on the die (21-Figure 6) to a self limiting penetration depth.

The contacts (61-Figure 8) are constructed such that a biasing force with which the clamping mechanism (clamp 89-Figure 8) presses the die (21-Figure 6) and the substrate (41-Figure 6) together is sufficient to cause the raised portions (73-Figure 6) on the contacts (61-Figure 8) to penetrate the pads (27-Figure 6) on the die (21-Figure 6). This is the lower limit of the biasing force. At the same time, the biasing force is selected to be less than a force required for the remaining portions of the contacts (61-Figure 8) to penetrate the pads (27-Figure 6) on the die (21-Figure 6). This is the upper limit of the biasing force.

35 USC §102 and 35 USC §103 Rejections Over Agahdel et al.

Agahdel et al. discloses a bare die carrier that includes a substrate 16 having a polymer layer 39 and

contact pads 40 (Figure 4) on the polymer layer 39 configured to electrically engage die pads 45 on the die 22. The contact pads 40 include particles 44 (Figure 5) embedded in a layer of a hard metal 46 which binds the particles 44 to the contact pads 40. In addition, a layer of nonoxidizing metal 48, such as gold, is deposited on the particles 44. As stated at column 6, lines 26-28 of Agahdel et al.: "the particles 44 penetrate any impurity such as an oxide layer which may have formed on the surface of the aluminum die pad 45." As stated at column 6, lines 45-50 of Agahdel et al.: "Using particle plated contact pads obviates the need to devise elaborate mechanical schemes to generate a wiping action to push aside any oxide layer on pad 45. Instead electrical contact is made by the particles penetrating through the oxide layer on pad 45 with a simple normal force."

In contrast, rather than being particles embedded in a metal, the present contacts comprise "metal bumps" and "points" which comprise "portions of the metal". The presently claimed construction is simpler, and allows the penetration depth to be more closely controlled than the embedded particles construction of Agahdel et al.

In order to emphasize this difference, independent claims 78, 87, 92 and 97 have been amended to include "points" recitations. Independent claims 78 and 87 have been amended to include "portions of the metal" recitations. Independent claims 92 and 97 have been amended to include "portions of the bump" recitations. Antecedent basis for "points" and "portions" is provided on page 9, line 9, of the specification. Antecedent basis for "metal" is provided on page 16, line 8 of the specification.

In addition, each of the independent claims have been amended to recite a penetration depth. Specifically, independent claim 78 recites "the penetration depth being from one half to two thirds of the thickness" of the pad.

Independent claims 87 and 92 recite "the penetration depth being at least 5000Å but less than two thirds of the thickness". Independent claim 97 recited the height of the points being "at least 5000Å" but less than "two thirds of the thickness". Antecedent basis for these recitations is contained in claims 2-4 of the parent case. In addition, these recitations have been added to page 18 of the specification.

In Agahdel et al. only an oxide layer on the pad 45 is penetrated. As oxide layers are very thin, on the order of angstroms, the penetration depth of the particles appears to be much less than presently claimed. Further, as argued above, the penetration depth cannot be as accurately controlled, as the particles will inherently have an unequal size and projected height. In contrast, the present contacts can be made using deposition techniques such as plating, stenciling and screen printing (page 17, line 9), such that the height of the points, and thus the penetration depths, can be more accurately controlled.

In view of this different construction, and the improved results it provides, the amended claims are submitted to be both novel and unobvious over Agahdel et al.

35 USC §103 Rejections Over Malhi et al. or Elder et al. in view of Nakano and Blonder et al. or Bindra et al.

With respect to the 35 USC §103 rejections based on the above references, the previous arguments of record in "Appellant's Brief" dated March 28, 2002 are restated.

35 USC §103 Rejections Over Nakano in view of Blonder et al. or Bindra et al.

With respect to the 35 USC §103 rejections based on the above references, the previous arguments of record in "Appellant's Brief" dated March 28, 2002 are restated.

Conclusion

In view of the amendments and arguments, favorable consideration and allowance of claims 78-82, 87, 88, 90-93 and 96-98 is requested. Should any issues remain, the Examiner is asked to contact the undersigned by telephone.

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Respectfully submitted:

STEPHEN A. GRATTON
Registration No. 28,418
Attorney for Applicants

2764 S. Braun Way
Lakewood, CO 80228
Telephone: (303) 989-6353
FAX (303) 989-6538

CERTIFICATE OF MAILING UNDER 37 C.F.R. §1.8

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as First Class mail in an envelope addressed to: Assistant Commissioner of Patents, BOX AMENDMENT (NON-FEE), Washington, D.C. on this 11th day of September, 2002.

September 11, 2002
Date of Signature

Stephen A. Gratton
Attorney for Applicants

Marked Version Of Amended Claims Showing Changes

78. (seven times amended) An apparatus for testing a semiconductor die having a plurality of pads comprising:

a plate;

a substrate on the plate comprising a plurality of contacts configured to electrically contact the pads;

a clamping mechanism attached to the plate configured to bias the contacts and the pads together with a force;

the plate, the substrate and the mechanism configured such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained between the mechanism and the substrate with the contacts in electrical contact with the pads; and

each contact comprising a bump comprising a metal deposited on the substrate and a plurality of spaced raised [portions] points having [projecting from the bump with] a height [, the raised portions] and comprising portions of the metal dimensioned to penetrate into a pad to a penetration depth equal to the height but less than a thickness of the pad, the bump dimensioned to limit further penetration of the [raised portions] points into the pad at the force, the height and the penetration depth being from one half to two thirds of the thickness.

87. (six times amended) An apparatus for testing a semiconductor die having a plurality of pads comprising:

a plate comprising a plurality of external leads;

a substrate on the plate comprising a plurality of contacts configured to electrically contact the pads;

a clamping mechanism attached to the plate configured to bias the contacts and the pads together with a force;

the plate, the substrate and the mechanism configured such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained

between the mechanism and the substrate with the contacts in electrical contact with the pads;

each contact comprising a bump comprising a metal and a plurality of spaced [raised portions] points [projecting from the bump with] having a height [, the raised portions] and comprising portions of the metal configured to penetrate into a pad with a penetration depth equal to the height but less than a thickness of the pad while a remainder of the bump limits further penetration, the height and the penetration depth being at least 5000Å but less than two thirds of the thickness, the force selected to be greater than a first force at which the [raised portions] points penetrate the pad but less than a second force at which the remainder of the bump penetrates the pad, the second force being from two to ten times the first force.

88. (five times amended) The apparatus of claim 87 wherein the height is [at least] 5000Å.

92. (five times amended) An apparatus for testing a semiconductor die having a plurality of pads comprising:

a plate;

a substrate on the plate comprising a plurality of contacts configured to electrically contact the pads;

a clamping mechanism attached to the plate configured to bias the contacts and the pads together with a force;

the plate, the substrate and the mechanism configured such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained between the mechanism and the substrate with the contacts in electrical contact with the pads;

each contact comprising a bump having a surface and a plurality of spaced [raised portions] points comprising portions of the bump projecting from the surface dimensioned to penetrate into a pad at the force by a

penetration depth equal to a height of the raised portions but less than a thickness of the pad while the surface limits further penetration into the pad, the height and the penetration depth being at least 5000Å but less than two thirds of the thickness, the force selected to be greater than a first force at which the [raised portions] points penetrate the pad but less than a second force at which the bump penetrates the pad.

97. (amended) An apparatus for testing a semiconductor die having a pad with a thickness comprising:

a plate;

a substrate on the plate comprising a contact configured to electrically contact the pad, the contact comprising a bump having a surface and at least one [raised portion] point comprising a portion of the bump projecting from the surface with a height of at least 5000Å, the [raised portion] point and the surface configured such that the [raised portion] point can penetrate into the pad to a penetration depth equal to the height but less than about two thirds of the thickness while the surface limits further penetration into the pad; and

a clamping mechanism attached to the plate configured to bias the die and the substrate together with a force selected to achieve penetration of the pad by the [raised portion] point but to prevent damage to the pad by the bump.